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though the shock was sufficiently severe to cause persons to rush out of the very substantial Capitol building in terror.

San Rafael is 13 miles distant. Buildings were slightly damaged.

Duncan's Mills is 50 miles distant. The shocks were distinct and were supposed to be earthquakes.

Mount Hamilton is 50 miles distant and 4200 feet higher, with many ranges of hills lying between. No record appeared on the large EWING seismograph. The duplex instrument shows a very small mark which is possibly due at least in part, to the explosion. It is, however, so small that it may be entirely due to the shifting of the pen by temperature, etc. I have examined the sheets of the DRAPER Self-Registering Barometer and find an exceedingly small change in the pencil line a little after 9^h 30^m, but it is very doubtful if this change corresponds to the arrival of the air-wave, since there are other such marks on the same sheet at other times of this day. E. S. H.

THE APPLICATION OF INTERFERENCE METHODS TO SPECTROSCOPIC MEASUREMENT, BY PROFESSOR MICHELSON.

The following report of a paper read by Professor MICHELSON in Edinburgh on August 6, is from the *Edinburg Scotsman* of August 8, 1892.

"The principal paper of the day was by Mr. A. MICHELSON, Professor-elect of Chicago University, on the application of interference methods to spectroscopic measurement. The ordinary methods of producing dispersion, such as by the prism or grating, sufficed, he explained, to separate lines when their distance apart was a fiftieth of the distance between the two sodium lines. In order to get more precise results, it would be necessary to multiply the size of the grating according to the degree of precision required. For the purposes of his investigation he had devised an apparatus which he called a wave compiler, which enabled him to produce interference of the rays which were being examined, and by altering the distance of the paths of the rays to vary the clearness of the interference fringes. If the light under examination were made up of two distinct sources, as in the case of sodium, a regular and periodic variation was obtained. If such a periodic variation was seen in the clearness of the fringes, they might argue with certainty that the light was a double one. Extending the investigation still further, if the curve was of any form, no matter how complex, then by mathematical relations Professor MICHELSON showed that they could deduce the form or distribution of the light, whether it was double, as in the case of sodium; or triple or quadruple, as in the case of other substances. He had experimented upon various substances—hydrogen, oxygen, sodium, zinc, cadmium and mercury—and in almost all cases he had found that the lines which appeared in the most powerful spectroscopes to be single, were doublets or triplets, and in some cases very much more complex. In the case of hydrogen, especially, they could alter the temperature and pressure with facility, and on examining the visibility curve of hydrogen he had found that the distribution of light in the source, deduced from these curves, was such as to indicate that the width of the component lines diminished as the pressure diminished, though not indefinitely, but approached a certain limit. This seemed to indicate that this limit, according to the kinetic theory, depended on the temperature of the gas. A much stronger confirmation of the truth of the theory was furnished by the application of DÖPPLER'S theory of the vibration of the radiating molecules of the substances examined. It had been argued that the fact of being able to get interference with such a wide difference of path—this difference of path had been increased from some 50,000 waves up to about 800,000 or 900,000—was that the effect of the motion of the molecule in the line of sight must be negligible, and that therefore the kinetic theory of gases, which was based upon that theory, must be wrong. A comparison of radiations from over twenty different substances gave numbers which in every case were of the order of magnitude required by the kinetic theory. This, perhaps, might be considered as the most direct proof that existed of the motion of the gaseous molecule.

"Professor MICHELSON'S wave compiler consists essentially of a plane parallel glass and two mirrors. Light from the radiating substance impinges on the plane parallel glass at an angle of 45°, and is partly reflected and partly transmitted, the two pencils striking the two mirrors at normal incidence, and being reflected back each on its own path, falling again upon the plane parallel plate, and there re-uniting to form a beam of light which can be observed by the eye or the telescope. One of the mirrors is moved in such a way as to be kept parallel with itself by means of a slow motion screw, thus producing a difference of path which causes a change in the clearness of the interference fringes from which the distribution of light before described is obtained. The PRESIDENT, in remarking upon Professor MICHELSON'S apparatus afterwards, said it seemed to increase the use of spectroscopic powers without the use of enormous prisms. The lines on ROWLAND'S instrument would require to be ruled across two feet in order to give the results which Professor MICHELSON obtained on a small surface."

NOVA AURIGÆ.

The new star which appeared in the constellation *Auriga* last winter gradually faded away until when last observed in April it was about the sixteenth magnitude. It was re-observed the morning of August 18 by Professors HOLDEN, SCHAEBERLE and myself, and found to have increased in brightness to about the 10.5 magnitude. All the observers agreed that its appearance differed from that of other stars of the same brightness in that its disk was larger and its light duller, but the moonlight interfered with further study of its character, and a small spectroscope was at once put on the telescope. The spectrum with weak dispersion consisted of three bright lines and a very faint continuous spectrum. The morning of August 20 I further examined its spectrum with a more powerful spectroscope attached to the 12-inch equatorial. One of the bright lines previously seen was resolved into three bright lines, which were at once recognized as the three characteristic nebular lines. The continuous spectrum was scarcely brighter than that of a twelfth magnitude star. Visual observations by Professor BARNARD with the 36-inch equatorial on the same morning also showed that the star is a nebula about three seconds of arc in diameter, with a stellar nucleus of the tenth magnitude, and that it has not moved appreciably since last March.

Further observations of the spectrum are in progress. The positions of the three nebular lines and seven other bright lines have been quite accurately determined. The positions of the three nebular lines would indicate that the nebula is moving towards us with a great velocity—about 175 miles per second.

The general character of the spectrum justifies us in calling this interesting object a planetary nebula. Whether we are to witness any further evolution remains to be seen. The broad and hazy character of the bright lines, and a number of peculiarities in their positions, give some promise of further changes. W. W. C.